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RA II WIGOS Project Newsletter

DEVELOPING SUPPORT FOR NATIONAL METEOROLOGICAL AND HYDROLOGICAL SERVICES IN SATELLITE DATA, PRODUCTS AND TRAINING

Contents of this issue

Preparation of GCOM-C “SHIKISAI” data products

(1) GCOM-C

The Global Change Observation Mission - Climate (GCOM-C), also called “SHIKISAI,” was launched from JAXA Tanegashima space center on Dec. 23, 2017. After a three-month initial check-out phase, the sensor calibration phase for preparation of the data release planned in December 2018 was started.

The GCOM-C is a middle-size satellite in the 800 km altitude sun-synchronous polar-orbit of ascending (descending) equatorial crossing local time of 22:30 (10:30) +/-15 minutes. It has an optical imager system, second-generation global imager (SGLI), which observes various parameters of the atmosphere, land, ocean, and cryosphere for monitoring and predicting the climate change and its influence. The SGLI consists of a visible and near-infrared radiometer (VNR) and infrared scanner (IRS) with 250 m spatial resolution, slant-view polarization observation, and a 380 nm near-ultraviolet (NUV) channel (Table 1) with 1150 km (VNR) or 1400 km (IRS) swath.

The calibration accuracy and stability of the SGLI will be improved and maintained by combining the multiple methods (Fig. 1) to observe small climate change signals. The SGLI is basically calibrated by integration spheres or reference radiometers which are traced to the national and international standards (references by National Institute of Advanced Industrial Science and Technology (AIST) and National Institute of Standards and Technology (NIST)) before launch, and is then calibrated by on-board diffusers after the launch. On-board temporal change of the diffuser reflectance will be evaluated and corrected by the internal lamp, monthly lunar observation, and vicarious calibration. We have confirmed that the expected sensor performance is better than the specification in the initial check-out phase (Okamura et al., 2018).

Table 1: SGLI observation channels

Sub-system	Channel	Center wavelength	Width	Standard radiance	Saturation radiance	Signal-to-noise ratio or NEΔT (TI)	Pixel size
		nm		W/m²/sr/μm or Kelvin			m
VNR	*VN01*	379.9	10.6	60	240–241	624–675	**250**/1000
	VN02	412.3	10.3	75	305–318	786–826	**250**/1000
	VN03	443.3	10.1	64	457–467	487–531	**250**/1000
	VN04	490.0	10.3	53	147–150	858–870	**250**/1000
	VN05	529.7	19.1	41	361–364	457–522	**250**/1000
	VN06	566.1	19.8	33	95–96	1027–1064	**250**/1000
	VN07	672.3	22.0	23	69–70	988–1088	**250**/1000
	VN08	672.4	21.9	25	213–217	537–564	**250**/1000
	VN09	763.1	11.4	40	351–359	1592–1746	250/**1000**
	VN10	867.1	20.9	8	37–38	470–510	**250**/1000
	VN11	867.4	20.8	30	305–306	471–511	**250**/1000
	PL01 + 60	672 .2	20.6	25	295	609	**1000**
	PL01 + 0				315	707	
	PL01 – 60				293	614	
	PL02 + 60	866.3	20.3	30	396	646	**1000**
	PL02 + 0				424	763	
	PL02 – 60				400	752	
IRS	*SW01*	1050	21.1	57	289.2	951.8	**1000**
	SW02	1390	20.1	8	118.9	347.3	**1000**
	SW03	1630	195.0	3	50.6	100.5	**250**/1000
	SW04	2210	50.4	1.9	21.7	378.7	**1000**
	TI01	10785	756	300K	340K	0.08K	**250**/500/1000
	TI02	11975	759	300K	340K	0.13K	**250**/500/1000

Cited from Okamura et al., 2018, "Pre-launch characterization and in-orbit calibration of GCOM-C/SGLI." Signal-to-noise ratio is defined at the standard radiance and IFOV shown by bold characters.

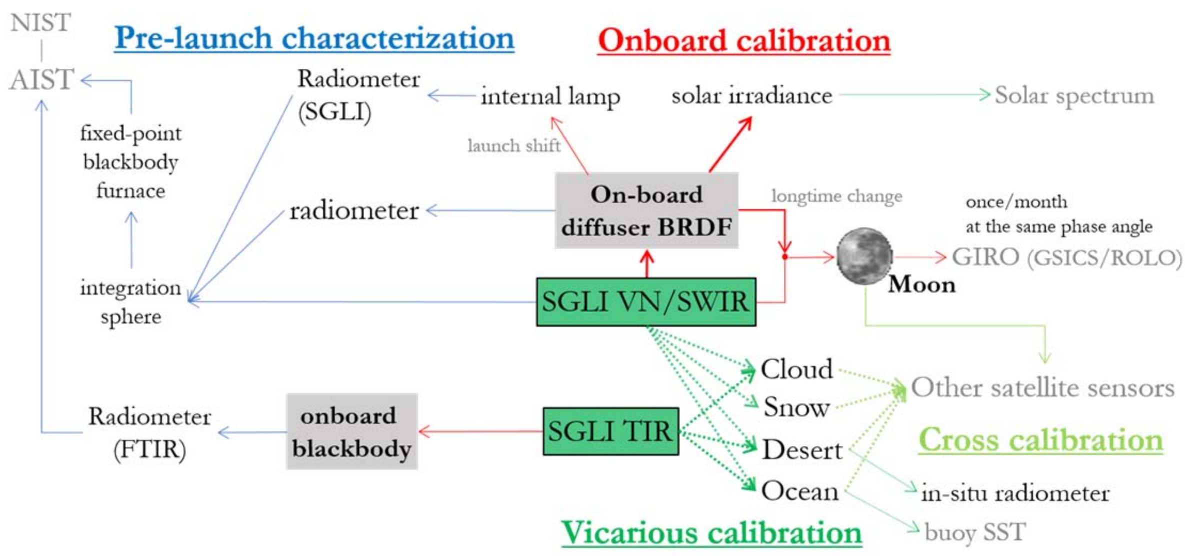

Figure 1: Calibration strategy of GCOM-C SGLI

(2) GCOM-C products

The GCOM-C science data products (Table 2) have been developed and validated by the collaborative team of JAXA Earth Observation Research Center and the GCOM-C principal investigators. Cloud flag has been validated by fish-eye cameras on the ground; cloud properties by comparison with other satellite products or SKYNET measurements; aerosol properties by SKYNET and AERONET data; radiation budget by BSRN; the land-area products by field campaigns and the flux-tower sites such as Asia Flux; sea surface temperature (SST) by iQuam dataset edited by NOAA; ocean color by MOBY, BOUSSOLE, AERONET-OC, and ship measurements; and cryosphere products by in situ measurements in snowfields, such as Hokkaido and Greenland.

Table 2: GCOM-C observation data products (standard)

Area	Group	Standard Product	Grid Size
Com-mon	Radiance	Top-of-atmosphere radiance (including system geometric correction)	VNR, SWI: Land/coast: 250 m, offshore: 1 km, polarimetry: 1 km TIR: Land/coast: 500 m, offshore: 1 km
Land	Surface reflectance	Precise geometric correction	250 m (equal-area grid [EQA] tile)
		Atmospheric corrected reflectance	250 m (EQA tile)
	Vegetation and carbon cycle	Vegetation index	250 m (EQA tile)
		Shadow index	
		Above-ground biomass	1 km (EQA tile)
		Vegetation roughness index	
		Fraction of absorbed photosynthetically active radiation	250 m (EQA tile)
		Leaf area index	
	Temperature	Surface temperature	250 m (EQA tile)
Atmosphere	Cloud	Cloud flag/Classification	1 km (EQA tile)
		Classified cloud fraction	1 km (EQA tile), 1/12 deg (global)
		Cloud top temp/height	
		Water cloud OT/effective radius	
		Ice cloud optical thickness	
	Aerosol	Aerosol by non-polarization	1 km (EQA tile), 1/12 deg (global)
		Aerosol over the land by polarization	
Ocean	Ocean color	Normalized water leaving radiance	250 m (coast), 1 km (offshore), 1/24 deg (global)
		Atmospheric correction parameters	
		Photosynthetically available radiation	
	In-water	Chlorophyll-a concentration	250 m (coast), 1 km (offshore), 1/24 deg (global)
		Suspended solid concentration	
		Colored dissolved organic matter	
	Temperature	Sea surface temperature	500 m (coast), 1 km (offshore), 1/24 deg (global)
Cryosphere	Area/ distribution	Snow and Ice covered area	250 m (EQA tile), 1 km (EQA tile)
		Okhotsk sea-ice distribution	250 m (scene)
	Surface properties	Snow and ice surface temperature	250 m (EQA tile), 1 km (EQA tile)
		Snow grain size of shallow layer	

(3) Observation examples

Even in the current initial calibration validation phase, we could confirm the possibility of the GCOM-C/SGLI measurements. The 250 m resolution of the SGLI enables detail measurements of the SST and ocean color of the ocean fronts and eddies even in bays and coasts (Fig. 2). Detail structures of snow and sea-ice areas can be monitored by the 250 m resolution of a shortwave (SW) infrared channel, SW03 (1.6 μm), in addition to the VNR channels (Fig. 3).

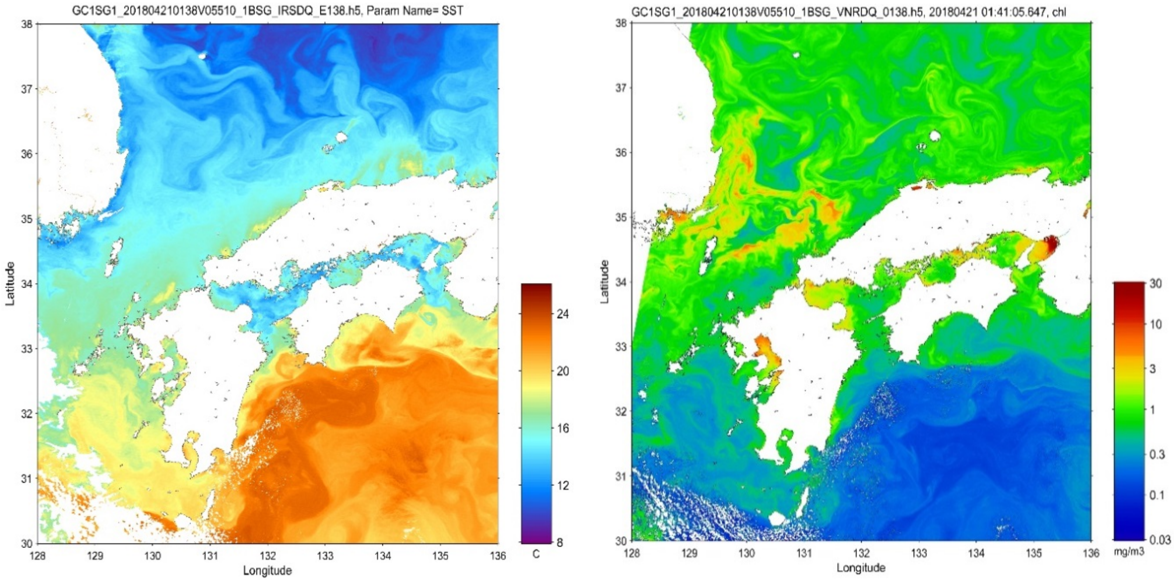

Figure 2: Sea surface temperature and chlorophyll-a concentration around western Japan captured by SHIKISAI on April 21, 2018

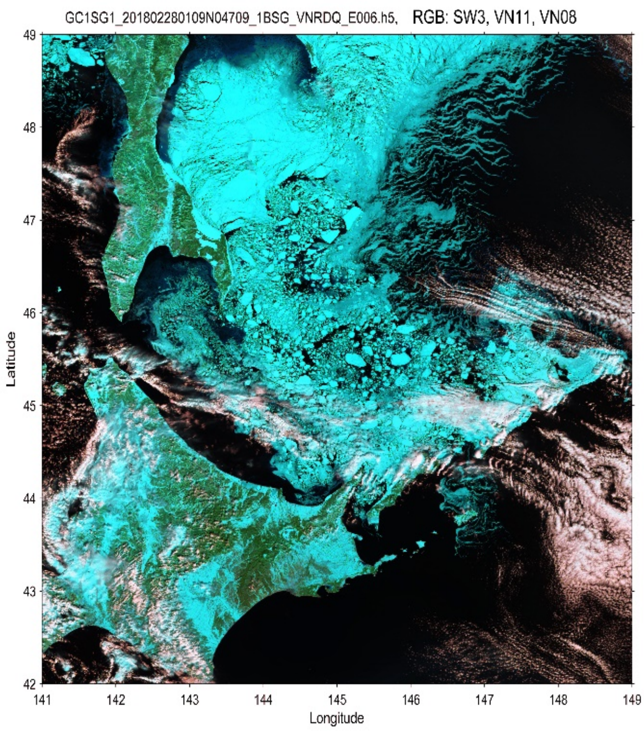

Figure 3: RGB image by 1.6 μm, 866 nm, and 672 nm channels around Hokkaido and the south of the Okhotsk Sea captured by SHIKISAI on Feb. 28, 2018. Light blue areas show snow or sea ice.

The 250 m resolution and 1400 km swath of IRS are expected to enable monitoring of the land temperature changes between day and night. Figure 4 shows an example around the Kinki area (in the center of Japan) under a hot summer in 2018. We can see extreme daytime heating in the low-vegetation city areas such as the Osaka Plain and Kyoto basin.

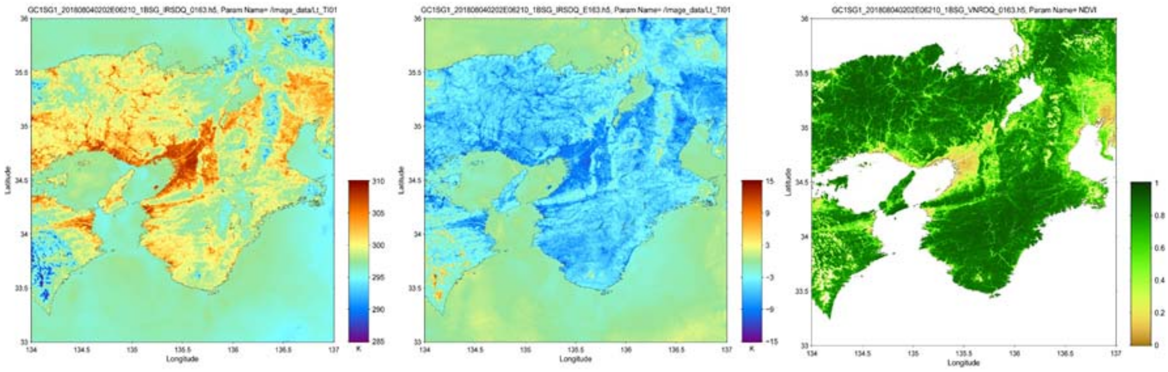

Figure 4: Brightness temperature of 11 μm (BT11), night-day difference of BT11, and vegetation index (NDVI) around Kinki area, Japan, captured by SHIKISAI on Aug. 4, 2018.

The SGLI is expected to improve estimation of aerosols over land areas, because the NUV channel is sensitive to the absorption of black carbon and dust aerosols, and the polarization channels extract the fine-mode aerosol signals without contamination of high land surface reflectance. Figure 5 is an example of the extreme fire-induced aerosol event in northwestern America on Aug. 19, 2018. The SGLI polarization radiance shows that the dense aerosol spreads widely and concentrates along valleys. The yellow (i.e., NUV is lower than other channels) areas of the RGB image are easily discriminated from white clouds and indicate that the dense plumes include the light-absorbing particles.

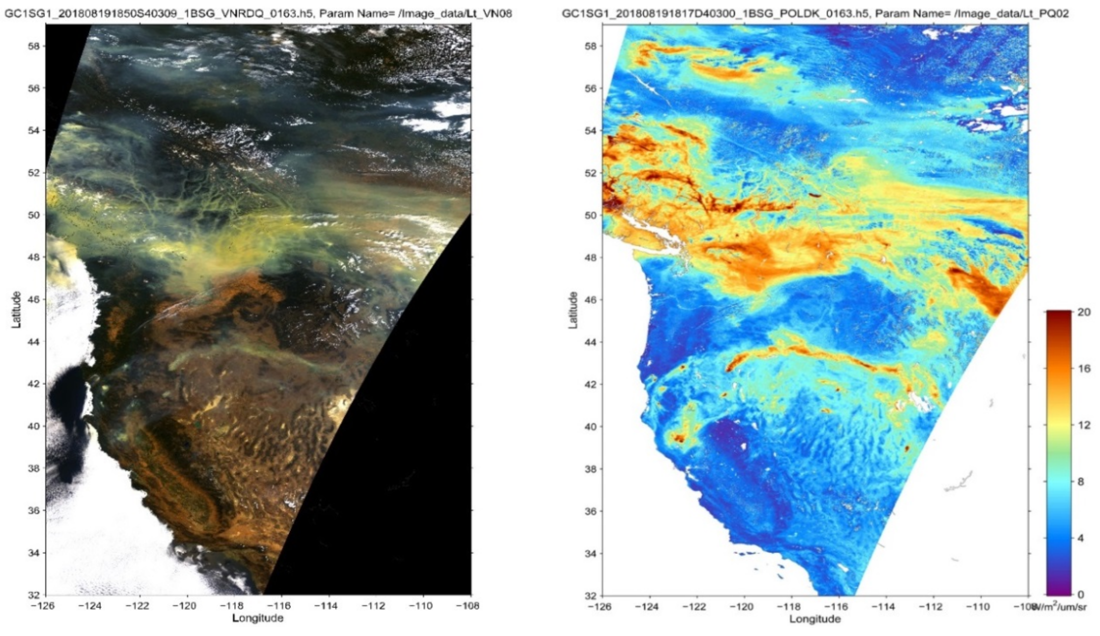

Figure 5: RGB image of 672 nm, 530 nm, and NUV (380 nm), and polarization radiance at 866 nm around the west coast of northwestern America captured by SHIKISAI on Aug. 19, 2018.

(4) Distribution of data product

The GCOM-C data is downlinked to the Svalbard receiving station and real-time data receiving stations, as well as JAXA stations in Japan. They are transmitted to JAXA GCOM-C mission operation system, and transferred into JAXA data providing system, G-portal (https://gportal.jaxa.jp/gpr/) (Fig. 6). All standard products (Level-1, geophysical data (Level-2), and the statistics (Level-3) products; see Table 2) will be freely open to the public through G-portal in December 2018. We hope the GCOM-C data will be widely used internationally and contribute to the monitoring and prediction research of climate change and its variability as one of the reliable fundamental data in the future.

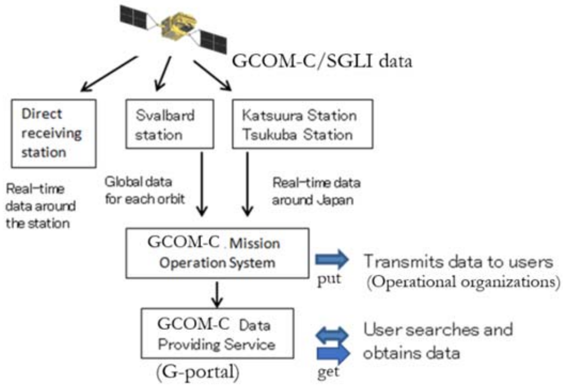

Fig. 6. SHIKISAI data flow

(Hiroshi Murakami, JAXA/EORC)

The 46th meeting of CGMS in Bengaluru, India, 3-8 June 2018

Background

CGMS provides an international forum for the exchange of technical information on geostationary and polar orbiting meteorological satellite systems.

The 46th CGMS was held on 3-8 June 2018 in Bengaluru, India. The meeting was hosted by ISRO.

The meeting was chaired by Mr. Tapan Misra, ISRO Satellite Center Director and Mr. Alain Ratier, EUMETSAT Director-General and Head of the CGMS Secretariat.

The Plenary session in the period 7-8 June 2018 was preceded by the four CGMS Working Groups (WG I: Global issues on satellite systems and telecommunication coordination, WG II: Satellite data and products, WG III: Operational continuity and contingency planning, and WG IV: Global data dissemination) as well as the meeting on space weather on Sunday in 3 June 2018.

Objectives of CGMS

The main objectives of CGMS are:

- To have a clear focus on coordination of long-term and sustainable satellite systems relevant to weather and climate to which both operational and R&D agencies contribute;
- To give a technical focus to the discussions handled by the group; and
- Through a close interaction with WMO, to respond as far as possible to requirements from WMO and related programmes (e.g. WIGOS, IOC, GCOS).

Plenary

The key outcomes in plenary session are summarized. Plenary adopted the new CGMS baseline, expressing the committed CGMS contribution to the space-based global observing system in response to the WMO Vision 2040 and agreed to analyse and document any gap between the WMO Vision 2040 and the CGMS baseline every five years to guide CGMS agencies in their planning for additional contributions and programmes. The new CGMS contingency plan was adopted and agreed to work towards optimising the observing system in view of potential gaps of microwave measurements for sea surface temperature and ice monitoring. The CEOS-CGMS WGClimate gap analysis report and coordinated action plan as well as the space agency response to the GCOS implementation plan was endorsed.

The creation of CGMS Space Weather Coordination Group (SWCG) was endorsed, to secure the coordination of CGMS member contributions to international space weather activities.

Plenary reconfirmed its commitment to support the establishment of an operational greenhouse gas monitoring system and its space-based component, as demonstrated through the input given to the WIGOS 2040 Vision.

Working Group I: Global Issues on Satellite Systems and Telecommunication Coordination

WG I and WG IV proposed a revised terms of reference and the renaming to ‘Satellite systems and operations’ in order to enhance the global aspect of its activities (endorsed by plenary) and reconfirmed the need for protecting EESS and passive frequency bands necessary for remote sensing in view of the World Radiocommunication Conference 2019 (WRC-19) and noted that space weather frequency protection will be addressed at the WRC-23.

WG I continued to take a strong lead in its work with the climate and forecast metadata convention for NetCDF, to ensure that CGMS members’ use of NetCDF is considered when updating the convention.

The new data collection platform designs will be presented to the upcoming SATCOM Forum 2018 and the meteorological data collection system workshop.

WG I agreed to address space situational awareness (space debris and collision avoidance) and large volume data circulation in future meetings.

Working Group III: Operational Continuity and Contingency Planning

WG III adopted a new CGMS Baseline that enumerates the observations, measurements, and services that form the CGMS contribution to the space-based global observing system and responds to end-user requirements expressed in WMO’s rolling review of requirements. The CGMS Baseline will strive to support the WMO Integrated Global Observing System (WIGOS) 2040 Vision and serves as CGMS’s response documenting what missions are currently flying or planned on being flown, and also adopted a process to actively conduct an annual risk assessment of CGMS's contribution towards its Baseline.

CGMS Contingency Plan was adopted to provide guidance and processes for identifying, mitigating, and coping with capability loss against the CGMS Baseline. The plan provides guidance to CGMS Members to ensure continuity of their missions, discusses steps Members can take to coordinate continuity among themselves, and steps CGMS can take to monitor and respond to losses.

Working Group IV: Global Data Dissemination

A revised WGIV terms of reference was proposed and the renaming to ‘Support for End Users’ in order to focus on the end user community (endorsed by plenary).

The Indian Ocean Data Coverage (IODC) data dissemination plan will be completed by end 2018, securing long term coordinated observations and data access of the Indian Ocean by CGMS members and users.

The global data exchange between CGMS space agencies are in place with future enhancements planned, and agreed to address the associated policies for data redistribution to users, and agreed to include access to space weather data requirements as part of its global coordination discussions on data access.

Space Weather Task Team

The transition of the Space Weather Task Team (SWTT) was recommended into a working group called Space Weather

Coordination Group (SWCG). The SWCG will support the continuity and integration of space-based observing capabilities for operational space weather products and services throughout CGMS and the user community, and in supporting the satellite operators in CGMS with regard to space weather phenomena. CGMS agreed to provide an input to the UNISPACE+50 priority 4 which is to develop a space weather roadmap for coordination and information exchange on space weather events and mitigation. SWCG agreed to work with WMO to secure the information flow on satellite space weather anomalies, and recommended to invite the International Space Environment Service (ISES) to become a CGMS observer (endorsed by plenary).

Working Group II (Satellite data and products) and International Science Working Groups (ISWG)

The significant progress in maturity of GSICS products and implementation of operational tools was emphasized, enabling a first ever GSICS assessment of the status of the satellite observing system.

WG II highlighted the continued progress made in the CGMS International Science Working Groups (ISWGs) in advancing the understanding and utilisation of satellite data in a wide range of activities. The ITWG (soundings) noted the importance of ensuring a baseline observing system in three polar orbiting planes; the IWWG (winds) the provision of high resolution AMVs for mesoscale, regional and nowcasting applications; and the IROWG (radio occultation) concerns related to the overall radio-occultation constellation in the future. The ICWG (clouds) and IPWG (precipitation) had progressed in the assessment of various algorithms and user engagement.

- Noted the significant capabilities of meteorological satellite data to support 'non-meteorological' applications.
- Discussed best practices for product generation, validation and impact studies and in particular the need for consistent quality control enabling easier intercomparison of the performance of different instruments and algorithms.
- Noted the need to strengthen the interaction with operational oceanography and marine meteorology, in particular for operational downstream services and the significant advances made in atmosphere-ocean coupled modelling.

Summary of ISWG is the following:

International TOVS WG

The ITWG reported that The 21st International TOVS Study Conference, ITSC-21, was hosted by EUMETSAT in Darmstadt, Germany, between 29 November and 5 December 2017. During the workshop the critical importance of satellite sounding data for numerical weather prediction (NWP) was again demonstrated and the strong requirement for state-of-the-art infrared and microwave sounders in at least three complementing orbital planes confirmed. As a consequence ITWG fully supports CMA's efforts to cover the early morning orbit starting with FY-3E. Additionally, the efficient use of high quality satellite data today also implies that any changes to the system has to be carefully analysed and prepared. Furthermore, further investments in spectroscopy are required in order to maximise the benefits of satellite data.

International Wind WG

The International Winds Working Group (IWWG) recently completed its 14th International Winds Workshop (IWW14), held on 23-27 April 2018 on Jeju Island, Korea. A specific highlight from the meeting was the result from the third AMV intercomparison with the following main outcomes:

- JMA had the best overall performance using a new HA method (1DVAR plus differential evolution);
- Differences between centres is greater in the height assignment;

- Common QI has real skill in filtering collocated AMVs for an improved statistical agreement; and
- Common Quality Indicator (QI) module (Fortran 90) was developed and supplied to the AMV producing centres.

International Radio-Occultation WG

The IROWG-6 meeting was held on 21-27 September 2017 in Estes Park, USA. The four key recommendations for CGMS-46 are:

- Ensure that both equatorial and polar components of COSMIC-2 are fully funded and launched
- IROWG recommends targeting at least 20,000 occultations/day providing good spatial and local time coverage, to be made freely available to the operational and research communities of Numerical Weather Prediction, Climate, and Space Weather.
- International space agencies to support mission preparation and implementation projects towards LEO-LEO microwave occultation and GNSS-RO&-Reflectometry demonstration missions. This should include recommending new OSSEs for these missions.
- IROWG stresses the importance of long-term archiving of the Level-0 data from both the agency-led and "commercial" missions. These long term costs should be included in mission budgets. Researchers need access to this data, and to information about the GNSSRO receiver performance, for climate reprocessing activities.

International Cloud WG

ICWG will convene its second meeting in November 2018 in Madison, Wisconsin, USA. ICWG is hoping to further collaboration with other CGMS groups (IWWG and IPWG) as well as GSICS and SCOPE-CM. The following recommendations for discussion at the CGMS plenary were put forward:

- To provide means to strengthen collaboration with other working groups (as first step would be good to have small funding to cover costs of co-chairs to attend each other's meetings).
- To provide a means to perform level-2 assessments prior to each workshop (space agencies could be encouraged to provide resources covering about 3 person months, e.g. though visiting scientist activities)
- To discuss in collaboration with CEOS WG Climate the organization of a level-3 cloud assessment (to be discussed at ICWG-2)
- To discuss the homogenization of the geostationary temporal sampling to 10 minutes. This recommendation came from the severe weather topical group but would aid in the global consistency of many products.

International Precipitation WG

The Primary accomplishments since CGMS-45 include:

- Maintained and updated the IPWG web page(http://www.isac.cnr.it/~ipwg/IPWG.html)
- Continue to develop an IPWG focused publication in the Quarterly Journal of Royal Meteorological Society
- Expanded the IPWG validation protocol to India
- Participated at training activities as part of the 8th Asia/Oceanic Meteorological Satellite Users' Conference
- Engaged with CGMS on topics of interest, including participation at CGMS sponsored meetings and engagement with other science working groups
- Engaged with other entities like CEOS, GEO, GEWEX, GSICS and other applications groups, including participation at relevant meetings

The IPWG-9 will be held at the Seoul Garden Hotel in Seoul, Korea on 5-9 November 2018. KMA and Yonsei University are the primary sponsors.

(Dohyeong Kim/KMA)

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From the Co-editors

The co-editors invite contributions to the newsletter. Although it is assumed that the major contributors for the time being will be satellite operators, we also welcome articles (short contributions of less than a page are fine) from all RA II Members, regardless of whether they are registered with the WMO Secretariat as members of the WIGOS Project Coordinating Group. We look forward to receiving your contributions to the newsletter.
(Dohyeong KIM, KMA, and Hiroshi KUNIMATSU, JMA)

RA II WIGOS Project Home Page

http://www.jma.go.jp/jma/jma-eng/satellite/ra2wigosproject/ra2wigosproject-intro_en_jma.html

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